

What is claimed is:

1. A singing voice synthesizing apparatus comprising:

- 5 a phoneme database that stores a plurality of voice fragment data formed of voice fragments each being a single phoneme or a phoneme chain of at least two concatenated phonemes, each of the plurality of voice fragment data comprising data of a deterministic component and data of a stochastic component;
- 10 an input device that inputs lyrics;
- a readout device that reads out from said phoneme database the voice fragment data corresponding to the inputted lyrics;
- 15 a duration time adjusting device that adjusts time duration of the read-out voice fragment data so as to match a desired tempo and manner of singing;
- an adjusting device that adjusts the deterministic component and the stochastic component of the read-out voice fragment so as to match a desired pitch; and
- 20 a synthesizing device that synthesizes a singing sound by sequentially concatenating the voice fragment data that have been adjusted by said duration time adjusting device and said adjusting device.
- 25 2. A singing voice synthesizing apparatus according to claim 1, wherein said phoneme database stores a plurality of voice fragment data having different musical expressions for a single phoneme or phoneme chain.
- 30 3. A singing voice synthesizing apparatus according to claim 2, wherein said musical expressions include at least one parameter selected from the group consisting of pitch, dynamics and tempo.
- 35 4. A singing voice synthesizing apparatus according to claim 1, wherein said phoneme database stores voice fragment data comprising elongated sounds that are each enunciated by elongating a single phoneme, voice fragment

data comprising consonant-to-vowel phoneme chains and vowel-to-consonant phoneme chains, voice fragment data comprising consonant-to-consonant phoneme chains, and voice fragment data comprising vowel-to-vowel phoneme chains.

5 5. A singing voice synthesizing apparatus according to claim 1, wherein each of said voice fragment data comprises a plurality of data corresponding respectively to a plurality of frames of a frame string formed by segmenting a corresponding one of the voice fragments, and wherein the data of the deterministic component and the data of the stochastic component of each of said voice fragment data each comprise a series of frequency domain data corresponding respectively to the plurality of frames of the frame string corresponding to each of the voice fragments.

10 6. A singing voice synthesizing apparatus according to claim 5, wherein said duration time adjusting device generates a frame string of a desired time length by repeating at least one frame of the plurality of frames of the frame string corresponding to each of the voice fragments, or by thinning out a predetermined number of frames of the plurality of frames of the frame string corresponding to each of the voice fragments.

15 7. A singing voice synthesizing apparatus according to claim 6, wherein said duration time adjusting device generates the frame string of a desired time length by repeating a plurality of frames of the frame string corresponding to each of the voice fragments, said duration time adjusting device repeating the plurality of frames in a first direction in which the frame string of a desired time length is generated and in a second direction opposite thereto.

20 8. A singing voice synthesizing apparatus according to claim 7, wherein when repeating the plurality of

frames of the frame string corresponding to the data of the stochastic component of each of the voice fragments in the first and second directions, said duration time adjusting device reverses a phase of a phase spectrum of the stochastic component.

9. A singing voice synthesizing apparatus according to claim 1, further comprising a fragment level adjusting device that performs smoothing processing or level adjusting processing on the deterministic component and the stochastic component contained in each of the voice fragment data when the voice fragment data are sequentially concatenated by said synthesizing device.

10. A singing voice synthesizing apparatus according to claim 5, further comprising a deterministic component generating device that changes only pitch of the deterministic component to a desired pitch while preserving the spectral envelope shape of the deterministic component contained in each of the voice fragment data when the voice fragment data are sequentially concatenated by said synthesizing device.

11. A singing voice synthesizing apparatus according to claim 5, wherein said phoneme database stores voice fragment data comprising elongated sounds that are each enunciated by elongating a single phoneme, said phoneme database further storing a flat spectrum as an amplitude spectrum of the stochastic component of each of the voice fragment data comprising each of the elongated sounds, obtained by multiplying the amplitude spectrum thereof by an inverse of a typical spectrum within an interval of the elongated sound.

12. A singing voice synthesizing apparatus according to claim 11, wherein the amplitude spectrum of the stochastic component of each of the voice fragment data comprising each of the elongated sounds is obtained by multiplying an amplitude spectrum of the stochastic

component calculated based on an amplitude spectrum of the deterministic component of the voice fragment data of the elongated sound, by the flat spectrum.

13. A singing voice synthesizing apparatus
 5 according to claim 12, wherein said phoneme database does not store amplitude spectra of stochastic components of voice fragment data comprising certain elongated sounds, and the flat spectrum stored as an amplitude spectrum of voice fragment data comprising at least one other
 10 elongated sound is used for synthesis of the certain sounds.

14. A singing voice synthesizing apparatus
 according to claim 12, wherein the amplitude spectrum of the stochastic component calculated based on the
 15 amplitude spectrum of the deterministic component has a gain thereof at 0Hz controlled according to a parameter for controlling a degree of huskiness.

15. A singing voice synthesizing method comprising the steps of:

20 storing in a phoneme database a plurality of voice fragment data formed of voice fragments each being a single phoneme or a phoneme chain of at least two concatenated phonemes, each of said plurality of voice fragment data comprising data of a deterministic
 25 component and data of a stochastic component;

reading out from said phoneme database the voice fragment data corresponding to lyrics inputted by an input device;

adjusting time duration of the read-out voice
 30 fragment data so as to match a desired tempo and manner of singing;

adjusting the deterministic component and the stochastic component of the read-out voice fragment so as to match a desired pitch; and

35 synthesizing a singing sound by sequentially

concatenating the voice fragment data that have been adjusted in respect of the time duration and the deterministic component and the stochastic component thereof.

- 5 16. A program for causing a computer to execute a singing voice synthesizing method comprising the steps of:

 storing in a phoneme database a plurality of voice fragment data formed of voice fragments each being a
10 single phoneme or a phoneme chain of at least two concatenated phonemes, each of said plurality of voice fragment data comprising data of a deterministic component and data of a stochastic component;

 reading out from said phoneme database the voice
15 fragment data corresponding to lyrics inputted by an input device;

 adjusting time duration of the read-out voice fragment data so as to match a desired tempo and manner of singing;

20 adjusting the deterministic component and the stochastic component of the read-out voice fragment so as to match a desired pitch; and

 synthesizing a singing sound by sequentially concatenating the voice fragment data that have been
25 adjusted in respect of the time duration and the deterministic component and the stochastic component thereof.

17. A mechanically readable storage medium storing instructions for causing a machine to execute a singing
30 voice synthesizing method comprising the steps of:

 storing in a phoneme database a plurality of voice fragment data formed of voice fragments each being a
 single phoneme or a phoneme chain of at least two concatenated phonemes, each of said plurality of voice
35 fragment data comprising data of a deterministic

component and data of a stochastic component;

reading out from said phoneme database the voice
fragment data corresponding to lyrics inputted by an
input device;

5 adjusting time duration of the read-out voice
fragment data so as to match a desired tempo and manner
of singing;

adjusting the deterministic component and the
stochastic component of the read-out voice fragment so as
10 to match a desired pitch; and

synthesizing a singing sound by sequentially
concatenating the voice fragment data that have been
adjusted in respect of the time duration and the
deterministic component and the stochastic component
15 thereof.